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Caltrans Division of Research, Innovation and System Information

Research Results

Blending Effects of Recycled Asphalt Pavement on New Asphalt Binders

How aged asphalt binders alter the properties of new asphalt binders

Pavement

JANUARY 2016

Project Title:
Blending Effects of Recycled Asphalt Pavements on Virgin Binders

Task Number: 2565

Start Date: April 1, 2013

Completion Date: September 30, 2014

Product Category: New or improved technical standard, plan, or specification

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WHAT WAS THE NEED?

Using reclaimed asphalt pavement (RAP) and recycled asphalt shingles (RAS) in new asphalt mixes is expected to reduce construction costs, conserve natural resources, and limit dumping of pavement materials in landfills. However, including a high percentage of RAP and RAS requires engineering adjustments to accommodate the aged, stiffer binder, which in turn requires quantifying the degree of blending between the aged and new binders, the performance grade of the blended binder, and the positive and negative impacts on short- and long-term performance.

Current methods for assessing the properties of blended binders use either chemical extraction and recovery of the aged binder or prediction based on the Hirsch model. The extraction and recovery method is not desirable because of the unknown effects of the chemical solvents on the binder. The Hirsch model requires assumptions regarding blending RAP and RAS binders with the new binder. A new analysis procedure for estimating a composite binder's rheological properties by testing mortars and fine aggregate mixes using established Superpave equipment is needed.

WHAT WAS OUR GOAL?

The goal was to develop and validate a simple procedure to assess recycled asphalt's contribution to composite binder properties using standard Superpave testing equipment.

Fine aggregate matrix specimens

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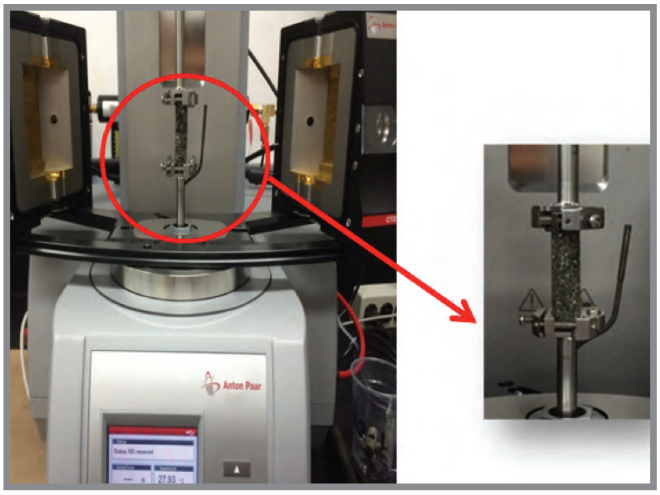
WHAT DID WE DO?

Caltrans, in partnership with the University of California Pavement Research Center at Davis, created a simplified procedure to investigate the effects of RAP and RAS on the performance grade of new asphalt binders. The team also developed an experimental design plan to evaluate the effects of the RAP and RAS type, source, quality, characteristics, and percentage. The researchers evaluated the rheological properties of these composite binders, accounting for short-term and long-term aging with respect to the performance in the field. A statistical analysis on the results was performed.

WHAT WAS THE OUTCOME?

The results indicate that testing asphalt mortar is probably limited to binder replacement rates from RAP not exceeding 25%. Preliminary results from fine aggregate matrix testing suggest that this method is both repeatable and reproducible and that representative results can be obtained from dynamic shear rheometer tests on fine aggregate matrix specimens. This test approach could be suitable for determining the performance grade of the blended binder and to obtain an indication of a mix's likely performance. The findings will be used to prepare a research plan to assess the performance properties of mixes containing large quantities of RAP and RAS in Task 2676.



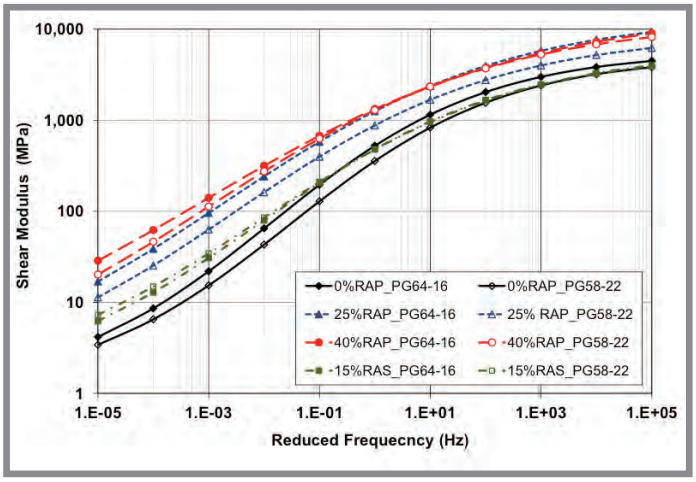
Testing fine aggregate matrix specimens in a dynamic shear rheometer

WHAT IS THE BENEFIT?

When designed properly, asphalt concrete mixes containing relatively large quantities of recycled asphalt can provide similar performance to conventional mixes using new materials. Using reclaimed asphalt reduces the demand for virgin materials to produce asphalt, offering a potentially sustainable option that could lower production costs.

LEARN MORE

To view the complete report:
www.ucprc.ucdavis.edu/PDF/UCPRC-TM-2014-06.pdf



Shear modulus curves of fine aggregate matrix mixes containing various percentages of RAP and RAS